Adverse childhood experiences and mental health problems in a nationally representative study of heterosexual, homosexual and bisexual Danes

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Non-heterosexual persons more often report adverse childhood experiences (ACEs) than heterosexuals, and they generally bear a greater burden of mental health challenges. However, population-based data on this topic are scarce. In a nationally representative study within the Project SEXUS, one of the world's largest cohort studies on sexual health, we used data from 57,479 individuals in Denmark to explore the interplay between ACEs and mental health problems among self-identified heterosexual, homosexual and bisexual persons, and among self-identified heterosexuals with or without same-sex sexual experience. Compared to heterosexuals, non-heterosexual persons were more likely to report most of the studied ACEs, with odds ratios (ORs) for the ACE category "abuse" ranging from 1.38 to 1.75 for homosexual women, from 1.76 to 2.65 for homosexual men, from 2.52 to 3.64 for bisexual women, and from 1.58 to 6.07 for bisexual men. Furthermore, non-heterosexual persons had consistently and statistically significantly higher odds for mental health problems (ORs: 1.50 to 4.63). Combinations of ACEs with a non-heterosexual identity resulted in markedly elevated odds for mental health problems, particularly among bisexual individuals. This included high odds for suicidal thoughts/attempts among bisexual persons with a history of "neglect" (women: OR=12.82; men: OR=35.24) and "abuse" (women: OR=11.81; men: OR=11.65). Among self-identified heterosexuals, combinations of ACEs with same-sex sexual experience were associated with consistently elevated odds for mental health problems (ORs: 2.22 to 12.04). The greater burden of ACEs among self-identified homosexuals and, most notably, bisexuals may account for part of their excess risk of mental health problems. These findings emphasize the public health importance of preventive measures to minimize the burden of ACEs and avert their harmful long-term effects. Moreover, they highlight the need to safeguard the welfare of children and adolescents with non-conforming expressions of sexuality.

Key words: Homosexuality, bisexuality, heterosexuality, adverse childhood experiences, mental health, self-harm, suicidality

(World Psychiatry 2022;21:427–435)

Adverse childhood experiences (ACEs) are increasingly being recognized as risk factors for a multitude of social and health-related problems, including low educational attainment, substance abuse, self-harm, suicidal behaviour and premature death[1-7]. ACEs include physical, psychological or sexual abuse, neglect, and household challenges such as parental death, divorce or separation, or someone in the family having drug addiction or mental illness.

Compared to self-identified heterosexuals, non-heterosexual individuals more often report ACEs[8-11], and a higher prevalence of mental health problems among non-heterosexuals has been observed in several studies[12-14]. However, despite scientific evidence indicating that non-heterosexuals are more likely to have experienced childhood adversities and to be burdened by mental health challenges, little research has explored the detailed associations of ACEs with mental health problems across sexual identity categories.

Additionally, investigations in this area using nationally representative samples with sufficiently large subgroups of sexual minorities are scarce and, for numerical reasons, studies often analyze homosexual and bisexual individuals together, although the social circumstances and mental health situations may differ considerably between these groups[13,15].

Within the Project SEXUS, one of the world's largest cohort studies on sexual health, we utilized a large and nationally representative sample of self-identified heterosexuals, homosexuals and bisexuals in Denmark to investigate associations of ACEs with measures of poor mental health across sexual identity subgroups. Further, to explore a different dimension of sexual orientation than sexual identity, we also investigated associations of ACEs with mental health problems among self-identified heterosexuals with or without same-sex sexual experience.

METHODS

Project SEXUS cohort

We utilized baseline data collected between 2017 and 2018 in Project SEXUS, a prospective national cohort study with a strict focus on sexual health and well-being and on the interplay between sexual and general health (www.projectsexus.dk)[16].

Overall, 62,675 individuals from a probability-based sample of 15 to 89 year-old Danes provided complete and logically consistent answers to a self-administered online questionnaire, resulting in a response rate of 34.6% according to criteria established by the American Association for Public Opinion Research (AAPOR response rate 1)[17]. An individual weighting procedure was applied in order to ensure national representativeness with respect to sex, year of birth, region of residence, marital status, cultural background and twin status[16,18].

The full Project SEXUS questionnaire covered more than 600 items detailing participants' socio-demographic background, health, lifestyle, relationship issues and sexuality. To include such a large number of items, while ensuring that each participant was presented with a manageable number of questions, some questions were only posed to half of the participants, while others were posed to the other half. Furthermore, logical filter questions

ensured that participants were asked a median of 180 questions, which took a median of 32 min to answer[18].

Sexual identity and same-sex sexual experience

All Project SEXUS respondents were asked to report their sexual identity. In this study, we excluded respondents who considered themselves asexual, those who could not place themselves in any of the presented sexual identity categories, and those who were undecided or did not know what to answer. To focus strictly on sexual identity rather than gender identity, the current study included data from 57,479 cis-gendered Project SEXUS participants, who self-identified as heterosexual, homosexual or bisexual and were 18 years or older when answering the online questionnaire.

Regardless of reported sexual identity, all respondents were asked about their sexual experiences with women and men since age 15 years. We defined individuals with same-sex sexual experience as those who reported at least one same-sex sexual encounter.

ACEs

To capture ACEs, half of the Project SEXUS respondents were asked a series of nine questions about their childhood, to determine if they had experienced one or more of the following before age 18 years: 1. a safe childhood with closeness and care, 2. physical abuse, 3. psychological abuse, 4. sexual abuse, 5. alcohol problems or drug addiction in the household, 6. mental illness or suicide attempts in the household, 7. parental divorce or separation, 8. maternal death or 9. paternal death.

Childhood experiences 1, 2, 3, 5 and 6 were measured using a five-point Likert-scale ranging from "to a very high extent" to "not at all". Experiences 4, 7, 8 and 9 were assessed using the response categories "yes" and "no". For respondents to meet our criteria for having had a particular ACE, we required that experience 1 be reported "to a low extent" or "not at all", that experience 2, 3, 5 or 6 be reported "to some extent", "to a high extent" or "to a very high extent", or that the answer concerning experience 4, 7, 8 or 9 be "yes".

A total of 29,244 respondents provided relevant answers to address associations between ACEs and mental health outcomes. To reduce analytic complexity and gain statistical robustness, the nine individual ACEs were grouped into three categories, respectively labelled "neglect" (ACE 1), "abuse" (ACEs 2 to 4) and "household challenges" (ACEs 5 to 9). Respondents were included in ACE categories "abuse" or "household challenges" if they had experienced at least one of the individual ACEs in that particular category. In addition, we created an ACE score based on the sum of ACEs for each respondent (ACE score range 0-9). In the statistical analyses, ACE scores were categorized as 0, 1-2 or 3+.

Mental health problems

All respondents were asked if they had ever received treatment by a doctor, a psychologist or a similar professional for a mental health problem, if they had ever harmed themselves on purpose without suicidal intent (e.g., by cutting, hitting or burning themselves), and if they had ever had suicidal thoughts with or without an actual suicide attempt.

Response categories were "yes", "no" and "I do not know". Respondents answering "yes" were considered to have the mental health outcome in question.

Statistical analyses

Initially, we estimated sexual identity-specific prevalence data of ACEs and mental health outcomes, and performed logistic regression to calculate associated prevalence odds ratios (ORs) with 95% confidence intervals (CIs), using heterosexuals as reference.

Next, we explored in more detail the interplay between ACEs and mental health problems across sexual identity categories in a series of logistic regression analyses. Specifically, we calculated ORs for associations of each of the three ACE categories ("neglect", "abuse", "household challenges") and each of the three ACE score categories (0, 1-2, 3+) with the studied mental health outcomes across sexual identity categories, using heterosexuals not reporting the ACE category in question and heterosexuals with an ACE score = 0, respectively, as reference.

Finally, in a supplementary analysis restricted to 27,697 self-identified heterosexuals from that half of study participants who had been asked questions about ACEs, we repeated the analysis for the association between ACE scores and mental health outcomes, this time stratifying on same-sex sexual experience ("any" vs. "none"). Specifically, we calculated ORs for the association between ACE score (0, 1-2, 3+) and mental health outcomes, using self-identified heterosexuals without same-sex sexual experience and an ACE score = 0 as reference.

We used demographically weighted data for all analyses. All logistic regression analyses were adjusted for age in 10-year categories and carried out using the nnet package in R (version 4.0.2).

RESULTS

ACEs across sexual identity categories

Non-heterosexual individuals were significantly more likely than heterosexuals to report a childhood that was not safe with closeness and care: OR=2.04 (95% CI: 1.12-3.72) for homosexual women; OR=1.89 (95% CI: 1.24-2.87) for homosexual men; OR=2.54 (95% CI: 1.87-3.44) for bisexual women; and OR=1.89 (95% CI: 1.25-2.84) for bisexual men (see Table 1).

A significantly higher proportion of non-heterosexual than heterosexual individuals, especially those with a bisexual identity, had experienced a childhood burdened by physical, psychological or sexual abuse. For homosexual women, the ORs for physical violence, psychological abuse and sexual abuse were, respectively, 1.38 (95% CI: 0.68-2.83), 1.75 (95% CI: 1.11-2.77), and 1.53 (95% CI: 0.77-3.05). For homosexual men, the corresponding ORs were 1.77 (95% CI: 1.18-2.66), 1.76 (95% CI: 1.30-2.40),

Table 1 Adverse childhood experiences (ACEs) among self-identified heterosexual, homosexual and bisexual individuals

	Women			Men		
	ACEs not reported N (%)	ACEs reported N (%)	OR (95% CI)	ACEs not reported N (%)	ACEs reported N (%)	OR (95% CI)
ACE category: Neglect						
Childhood was not safe with closeness and care						
Heterosexual	13,516 (92.4)	1,124 (7.6)	1 (ref.)	12,338 (94.0)	770 (6.0)	1 (ref.)
Homosexual	256 (85.5)	40 (14.5)	2.04 (1.12-3.72)	440 (89.6)	49 (10.4)	1.89 (1.24-2.87)
Bisexual	374 (84.4)	69 (15.6)	2.54 (1.87-3.44)	199 (89.6)	23 (10.4)	1.89 (1.25-2.84)
ACE category: Abuse						
Childhood was burdened by physical violence						
Heterosexual	13,591 (93.1)	1,021 (6.9)	1 (ref.)	12,165 (92.9)	926 (7.1)	1 (ref.)
Homosexual	270 (90.5)	25 (9.5)	1.38 (0.68-2.83)	432 (88.7)	54 (11.3)	1.77 (1.18-2.66)
Bisexual	377 (85.0)	64 (15.0)	2.52 (1.85-3.42)	196 (89.9)	22 (10.1)	1.58 (1.04-2.40)
Childhood was burdened by psychological abuse						
Heterosexual	11,992 (82.8)	2,605 (17.2)	1 (ref.)	11,438 (86.8)	1,640 (13.2)	1 (ref.)
Homosexual	214 (70.1)	81 (29.9)	1.75 (1.11-2.77)	389 (77.5)	100 (22.5)	1.76 (1.30-2.40)
Bisexual	276 (61.4)	167 (38.6)	2.65 (2.12-3.31)	171 (76.3)	50 (23.7)	1.89 (1.41-2.53)
Experienced sexual abuse in childhood						
Heterosexual	13,605 (94.0)	910 (6.0)	1 (ref.)	13,012 (99.2)	105 (0.8)	1 (ref.)
Homosexual	259 (89.7)	35 (10.3)	1.53 (0.77-3.05)	475 (97.8)	10 (2.2)	2.65 (1.10-6.39)
Bisexual	346 (78.8)	92 (21.2)	3.64 (2.77-4.78)	211 (95.0)	10 (5.0)	6.07 (3.33-11.05)
ACE category: Household challenges						
Someone in household had alcohol problems or drug addiction						
Heterosexual	12,237 (84.8)	2,332 (15.2)	1 (ref.)	11,413 (87.2)	1,636 (12.8)	1 (ref.)
Homosexual	216 (76.1)	78 (23.9)	1.48 (0.90-2.43)	402 (85.7)	84 (14.3)	1.07 (0.74-1.55)
Bisexual	319 (74.0)	120 (26.0)	1.80 (1.41-2.32)	180 (83.3)	35 (16.7)	1.28 (0.91-1.80)
Someone in household was mentally ill or tried to commit suicide						
Heterosexual	12,918 (90.2)	1,491 (9.8)	1 (ref.)	11,997 (92.6)	914 (7.4)	1 (ref.)
Homosexual	237 (83.3)	49 (16.7)	1.63 (0.92-2.89)	430 (86.0)	55 (14.0)	1.95 (1.34-2.82)
Bisexual	329 (76.2)	104 (23.8)	2.52 (1.95-3.27)	188 (88.5)	22 (11.5)	1.55 (1.04-2.32)
Parents got divorced/split up						
Heterosexual	11,281 (78.8)	3,322 (21.2)	1 (ref.)	10,607 (79.5)	2,471 (20.5)	1 (ref.)
Homosexual	203 (69.8)	93 (30.2)	1.14 (0.72-1.81)	370 (70.2)	117 (29.8)	1.37 (1.03-1.83)
Bisexual	257 (58.2)	186 (41.8)	1.80 (1.44-2.25)	162 (70.5)	60 (29.5)	1.32 (1.00-1.74)
Mother died						
Heterosexual	14,330 (97.8)	299 (2.2)	1 (ref.)	12,718 (97.2)	385 (2.8)	1 (ref.)
Homosexual	291 (98.1)	5 (1.9)	1.15 (0.24-5.38)	482 (99.0)	8 (1.0)	0.46 (0.13-1.63)
Bisexual	432 (97.7)	11 (2.3)	1.47 (0.72-3.02)	206 (94.2)	12 (5.8)	2.96 (1.71-5.12)
Father died						
Heterosexual	13,978 (95.4)	629 (4.6)	1 (ref.)	12,317 (94.5)	751 (5.5)	1 (ref.)
Homosexual	277 (94.2)	17 (5.8)	1.62 (0.66-3.96)	468 (96.8)	20 (3.2)	0.66 (0.32-1.36)
Bisexual	420 (95.1)	21 (4.9)	1.40 (0.85-2.31)	204 (94.0)	15 (6.0)	1.32 (0.78-2.24)

OR – odds ratio adjusted for age in 10-year categories

and 2.65 (95% CI: 1.10-6.39). For bisexual women, the ORs were 2.52 (95% CI: 1.85-3.42), 2.65 (95% CI: 2.12-3.31), and 3.64 (95% CI: 2.77-4.78). For bisexual men, the ORs were 1.58 (95% CI: 1.04-2.40), 1.89 (95% CI: 1.41-2.53), and 6.07 (95% CI: 3.33-11.05) (see Table 1).

Several challenges within the household were reported significantly more often by non-heterosexual than heterosexual individuals. In particular, more bisexual women (OR=2.52, 95% CI: 1.95-3.27), homosexual men (OR=1.95, 95% CI: 1.34-2.82) and bisexual men (OR=1.55, 95% CI: 1.04-2.32) than heterosexual peers were raised in households where someone was mentally ill or had tried to commit suicide; more bisexual women (OR=1.80, 95% CI: 1.44-2.25), homosexual men (OR=1.37, 95% CI: 1.03-1.83) and bisexual men (OR=1.32, 95% CI: 1.00-1.74) than heterosexual peers had parents who got divorced or split up; and more bisexual than heterosexual men experienced maternal death before age 18 years (OR=2.96, 95% CI: 1.71-5.12) (see Table 1).

Mental health problems across sexual identity categories

Mental health problems were markedly more common among non-heterosexual than heterosexual individuals (see Table 2). In particular, homosexual women were significantly more likely than heterosexual women to have received treatment for a mental health problem (OR=1.66, 95% CI: 1.23-2.24), to have ever harmed themselves on purpose without suicidal intent (OR=2.28, 95% CI: 1.57-3.32), and to have ever had suicidal thoughts or attempted suicide (OR=1.79; 95% CI: 1.32-2.42). The corresponding ORs for homosexual men were 2.33 (95% CI: 1.92-2.83), 1.50 (95% CI: 1.07-2.09), and 2.42 (95% CI: 1.99-2.93). Those for bisexual women were 2.66 (95% CI: 2.26-3.14), 4.46 (95% CI: 3.74-5.31), and 3.56 (95% CI: 3.03-4.18). Those for bisexual men were 2.44 (95% CI: 2.04-2.93), 4.63 (95% CI: 3.69-5.82), and 3.26 (95% CI: 2.71-3.91).

Associations between ACEs and mental health problems across sexual identity categories

Across sexual identity categories, individuals reporting ACEs were more likely to have mental health problems than those without ACEs (Table 3), and higher ACE scores were associated with higher odds of mental health problems (Table 4).

Among homosexual women, those with a history of "neglect" had markedly elevated odds of having ever performed self-harm (OR=10.81, 95% CI: 3.20-36.50) and of having had suicidal thoughts or attempted suicide (OR=5.06, 95% CI: 1.59-16.09). High odds of having performed self-harm (OR=7.19, 95% CI: 3.09-16.72) and of having had suicidal thoughts or attempted suicide (OR=7.13, 95% CI: 3.30-15.38) were also observed among homosexual women with a history of "abuse". Among homosexual men, those with a history of "neglect" or "abuse" had ORs of having had suicidal thoughts/attempts, respectively, of 14.73 (95% CI: 5.44-39.93) and 9.87 (95% CI: 5.48-17.78).

Among bisexual women, those with a history of "neglect" had ORs of having performed self-harm and of having had suicidal thoughts/attempts, respectively, of 13.93 (95% CI: 7.52-25.81) and 12.82 (95% CI: 6.20-26.48), and those with a history of "abuse" had corresponding ORs of 14.11 (95% CI: 9.90-20.11) and 11.81 (95% CI: 8.10-17.21). Among bisexual men, those with a history

Table 2 Mental health problems among self-identified heterosexual, homosexual and bisexual individuals

	Women			Men		
	Mental health problem not reported N (%)	Mental health problem reported N (%)	OR (95% CI)	Mental health problem not reported N (%)	Mental health problem reported N (%)	OR (95% CI)
Ever received treatment for a mental health problem						
Heterosexual	17,344 (62.6)	11,168 (37.4)	1 (ref.)	20,570 (78.7)	5,276 (21.3)	1 (ref.)
Homosexual	256 (44.6)	321 (55.4)	1.66 (1.23-2.24)	534 (59.0)	390 (41.0)	2.33 (1.92-2.83)
Bisexual	307 (34.8)	562 (65.2)	2.66 (2.26-3.14)	266 (58.0)	182 (42.0)	2.44 (2.04-2.93)
Ever performed self-harm						
Heterosexual	26,023 (91.9)	2,555 (8.1)	1 (ref.)	24,826 (95.2)	1,051 (4.8)	1 (ref.)
Homosexual	467 (77.2)	111 (22.8)	2.28 (1.57-3.32)	861 (90.8)	65 (9.2)	1.50 (1.07-2.09)
Bisexual	523 (58.8)	338 (41.2)	4.46 (3.74-5.31)	362 (77.6)	84 (22.4)	4.63 (3.69-5.82)
Ever had suicidal thoughts/attempted suicide						
Heterosexual	21,049 (75.8)	7,175 (24.2)	1 (ref.)	20,579 (78.8)	4,965 (21.2)	1 (ref.)
Homosexual	341 (57.6)	234 (42.4)	1.79 (1.32-2.42)	546 (56.9)	368 (43.1)	2.42 (1.99-2.93)
Bisexual	348 (39.0)	514 (61.0)	3.56 (3.03-4.18)	237 (50.0)	202 (50.0)	3.26 (2.71-3.91)

OR – odds ratio adjusted for age in 10-year categories

Table 3 Associations between categorized adverse childhood experiences (ACEs) and mental health problems among self-identified heterosexual, homosexual and bisexual individuals

	Women			Men		
	Heterosexual OR (95% CI)	Homosexual OR (95% CI)	Bisexual OR (95% CI)	Heterosexual OR (95% CI)	Homosexual OR (95% CI)	Bisexual OR (95% CI)
Ever received treatment for a mental health problem						
ACE category: Neglect						
ACE not reported	1 (ref.)	1.73 (1.09-2.74)	2.78 (2.18-3.55)	1 (ref.)	2.45 (1.85-3.25)	2.62 (2.00-3.44)
ACE reported	2.98 (2.60-3.40)	2.46 (0.78-7.78)	8.10 (3.82-17.16)	3.08 (2.66-3.58)	6.30 (2.78-14.28)	7.76 (3.44-17.48)
ACE category: Abuse						
ACE not reported	1 (ref.)	1.60 (0.95-2.72)	2.54 (1.87-3.43)	1 (ref.)	2.65 (1.95-3.59)	2.47 (1.82-3.34)
ACE reported	2.88 (2.64-3.14)	3.90 (1.80-8.45)	6.32 (4.37-9.14)	2.94 (2.66-3.25)	4.87 (2.84-8.36)	8.00 (4.77-13.43)
ACE category: Household challenges						
ACE not reported	1 (ref.)	1.66 (0.92-2.99)	2.29 (1.63-3.21)	1 (ref.)	3.27 (2.30-4.63)	2.48 (1.75-3.54)
ACE reported	1.84 (1.71-1.98)	2.90 (1.56-5.42)	5.77 (4.17-7.99)	1.86 (1.71-2.02)	3.10 (2.07-4.63)	5.21 (3.58-7.59)
Ever performed self-harm						
ACE category: Neglect						
ACE not reported	1 (ref.)	2.42 (1.35-4.36)	4.76 (3.62-6.27)	1 (ref.)	1.41 (0.84-2.34)	3.72 (2.59-5.36)
ACE reported	4.71 (3.86-5.75)	10.81 (3.20-36.50)	13.93 (7.52-25.81)	3.14 (2.46-4.02)	4.35 (1.45-13.05)	56.86 (23.61-136.97)
ACE category: Abuse						
ACE not reported	1 (ref.)	3.01 (1.54-5.92)	3.80 (2.61-5.53)	1 (ref.)	1.34 (0.71-2.50)	4.54 (2.99-6.90)
ACE reported	3.93 (3.42-4.51)	7.19 (3.09-16.72)	14.11 (9.90-20.11)	4.23 (3.58-5.00)	5.82 (2.85-11.85)	16.97 (9.77-29.46)
ACE category: Household challenges						
ACE not reported	1 (ref.)	2.69 (1.24-5.86)	5.14 (3.41-7.74)	1 (ref.)	1.29 (0.60-2.79)	4.99 (3.09-8.06)
ACE reported	2.32 (2.03-2.65)	5.91 (2.88-12.13)	9.19 (6.67-12.64)	2.12 (1.81-2.49)	3.07 (1.70-5.53)	8.85 (5.67-13.81)
Ever had suicidal thoughts/attempted suicide						
ACE category: Neglect						
ACE not reported	1 (ref.)	1.87 (1.17-2.99)	3.90 (3.05-4.98)	1 (ref.)	2.24 (1.68-2.99)	3.22 (2.44-4.24)
ACE reported	4.46 (3.90-5.10)	5.06 (1.59-16.09)	12.82 (6.20-26.48)	3.58 (3.07-4.17)	14.73 (5.44-39.93)	35.24 (10.70-116.02)
ACE category: Abuse						
ACE not reported	1 (ref.)	1.76 (1.01-3.05)	3.50 (2.58-4.76)	1 (ref.)	2.23 (1.62-3.05)	3.40 (2.51-4.62)
ACE reported	4.29 (3.91-4.69)	7.13 (3.30-15.38)	11.81 (8.10-17.21)	3.51 (3.16-3.89)	9.87 (5.48-17.78)	11.65 (6.56-20.69)
ACE category: Household challenges						
ACE not reported	1 (ref.)	1.73 (0.93-3.21)	3.60 (2.56-5.08)	1 (ref.)	2.70 (1.88-3.88)	3.71 (2.62-5.26)
ACE reported	2.20 (2.02-2.38)	4.31 (2.33-7.97)	8.25 (6.01-11.32)	1.82 (1.67-1.98)	3.84 (2.58-5.72)	6.02 (4.03-9.00)

OR – odds ratio adjusted for age in 10-year categories

of "neglect" had ORs of having performed self-harm and of having had suicidal thoughts/attempts as high as, respectively, 56.86 (95% CI: 23.61-136.97) and 35.24 (95% CI: 10.70-116.02) (see Table 3).

Similarly, odds of self-harm (women: OR=22.82, 95% CI: 14.34-36.32; men: OR=28.28, 95% CI: 13.83-57.85) and of suicidal thoughts/attempts (women: OR=16.61, 95% CI: 10.01-27.57; men: OR=24.26, 95% CI: 10.64-55.32) were markedly greater among bisexuals with at least three ACEs compared with heterosexual peers without ACEs (see Table 4).

Associations between ACEs and mental health problems among self-identified heterosexuals with or without same-sex sexual experience

Among self-identified heterosexuals, individuals with any same-sex sexual experience were generally more likely than indi-

Table 4 Associations between number of adverse childhood experiences (ACEs) and mental health problems among self-identified heterosexual, homosexual and bisexual individuals

	Women			Men		
	Heterosexual OR (95% CI)	Homosexual OR (95% CI)	Bisexual OR (95% CI)	Heterosexual OR (95% CI)	Homosexual OR (95% CI)	Bisexual OR (95% CI)
Ever received treatment for a mental health problem						
0 ACEs	1 (ref.)	1.56 (0.81-2.99)	2.23 (1.50-3.32)	1 (ref.)	3.61 (2.48-5.25)	2.07 (1.37-3.14)
1-2 ACEs	1.74 (1.61-1.89)	3.36 (1.59-7.10)	4.63 (3.25-6.61)	1.93 (1.76-2.11)	2.61 (1.64-4.15)	5.87 (3.95-8.73)
3+ ACEs	3.82 (3.41-4.27)	3.74 (1.50-9.31)	9.18 (5.49-15.36)	3.63 (3.19-4.13)	8.19 (4.08-16.43)	8.28 (4.32-15.87)
Ever performed self-harm						
0 ACEs	1 (ref.)	2.30 (0.89-5.94)	4.25 (2.51-7.18)	1 (ref.)	1.82 (0.83-3.99)	4.46 (2.42-8.23)
1-2 ACEs	2.18 (1.86-2.55)	9.96 (4.34-22.85)	7.89 (5.36-11.62)	2.37 (1.97-2.85)	1.75 (0.72-4.22)	8.84 (5.47-14.30)
3+ ACEs	6.06 (5.06-7.25)	6.41 (2.13-19.30)	22.82 (14.34-36.32)	5.34 (4.28-6.65)	9.53 (4.25-21.37)	28.28 (13.83-57.85)
Ever had suicidal thoughts/attempted suicide						
0 ACEs	1 (ref.)	1.58 (0.77-3.25)	3.01 (1.99-4.56)	1 (ref.)	2.61 (1.75-3.88)	3.91 (2.65-5.78)
1-2 ACEs	2.17 (1.98-2.38)	5.07 (2.46-10.47)	8.15 (5.70-11.68)	1.95 (1.78-2.14)	4.02 (2.58-6.27)	4.65 (3.06-7.06)
3+ ACEs	5.95 (5.29-6.70)	7.13 (2.84-17.89)	16.61 (10.01-27.57)	4.15 (3.64-4.74)	9.49 (4.65-19.36)	24.26 (10.64-55.32)

OR – odds ratio adjusted for age in 10-year categories

Table 5 Associations between number of adverse childhood experiences (ACEs) and mental health problems among self-identified heterosexual individuals with or without same-sex sexual experience

	Women				Men			
	No same-sex sexual experience N (%)	OR (95% CI)	Any same-sex sexual experience N (%)	OR (95% CI)	No same-sex sexual experience N (%)	OR (95% CI)	Any same-sex sexual experience N (%)	OR (95% CI)
Ever received treatment for a mental health problem								
0 ACEs	7,574 (26.7)	1 (ref.)	346 (46.1)	1.89 (1.49-2.40)	7,716 (14.9)	1 (ref.)	176 (23.3)	1.58 (1.11-2.24)
1-2 ACEs	4,342 (40.4)	1.71 (1.58-1.86)	374 (60.6)	3.27 (2.60-4.12)	3,832 (25.8)	1.90 (1.73-2.09)	167 (38.1)	3.01 (2.22-4.08)
3+ ACEs	1,620 (60.2)	3.63 (3.22-4.08)	252 (76.9)	7.21 (5.26-9.88)	1,084 (40.2)	3.63 (3.18-4.15)	70 (45.5)	3.99 (2.55-6.24)
Ever performed self-harm								
0 ACEs	7,600 (3.9)	1 (ref.)	348 (8.6)	2.14 (1.37-3.33)	7,730 (2.5)	1 (ref.)	176 (6.4)	3.15 (1.69-5.91)
1-2 ACEs	4,360 (9.5)	2.14 (1.81-2.52)	371 (17.7)	4.39 (3.15-6.12)	3,841 (6.8)	2.49 (2.06-3.00)	168 (5.6)	2.22 (1.16-4.24)
3+ ACEs	1,616 (18.5)	5.74 (4.73-6.97)	250 (29.7)	11.25 (7.97-15.88)	1,079 (12.5)	5.27 (4.18-6.63)	69 (23.5)	12.04 (6.79-21.33)
Ever had suicidal thoughts/attempted suicide								
0 ACEs	7,521 (14.3)	1 (ref.)	343 (29.3)	2.11 (1.62-2.75)	7,637 (14.4)	1 (ref.)	174 (34.5)	3.23 (2.34-4.47)
1-2 ACEs	4,296 (28.4)	2.14 (1.94-2.36)	365 (45.3)	3.96 (3.14-5.00)	3,779 (26.3)	1.98 (1.80-2.18)	162 (39.0)	3.49 (2.56-4.76)
3+ ACEs	1,593 (51.8)	5.84 (5.15-6.62)	249 (63.6)	8.78 (6.62-11.66)	1,067 (41.7)	4.09 (3.57-4.69)	68 (61.8)	9.08 (5.65-14.59)

OR – odds ratio adjusted for age in 10-year categories

viduals without such experience to report ACEs. Further, mental health problems were significantly more common among those with same-sex sexual experience than among those without such experience, even in strata of individuals reporting no ACEs (see Table 5).

Moreover, combinations of ACEs with any same-sex sexual experience were associated with markedly elevated odds of all studied mental health problems (ORs: 2.22 to 12.04). For instance, heterosexuals with same-sex sexual experience and at least three ACEs had more than 10-fold greater odds of self-harm than the reference group of heterosexual individuals with no same-sex sexual experience and no ACEs (women: OR=11.25, 95% CI: 7.97-15.88; men: OR=12.04, 95% CI: 6.79-21.33) (see Table 5).

DISCUSSION

In this nationally representative study of 18 to 89 year-old Danes, non-heterosexual individuals reported ACEs markedly more often than heterosexuals. A similar finding has been previously reported in the literature, although mostly in smaller and less representative samples[8-11], and different interpretations have been offered. Firstly, it has been hypothesized that childhood maltreatment could independently influence adult sexual orientation[10,19], although no studies have thus far been able to reach firm conclusions on the causal dynamics of such a relationship. Secondly, it has been suggested that a nascent non-heterosexual identity might increase the risk of childhood adversities through two different pathways: a) adolescents who disclose their non-heterosexual orientation may be targeted for maltreatment[10,19], and b) children who will later form a non-heterosexual identity may be more likely to display gender non-conforming behaviours, which could increase their risk of maltreatment[10,19,20].

Regarding the latter hypothesis, several studies have found childhood gender non-conformity to be more prevalent among non-heterosexual individuals[21-23]. In a small study including 142 non-heterosexual and 148 heterosexual individuals, the reported excess of childhood harassment among non-heterosexuals diminished after controlling for childhood gender non-conformity[24]. A similar dynamic may have been at play in our study, as we previously reported a considerably higher prevalence of childhood gender non-conformity among homosexual (women: 57.5%; men: 54.6%) and bisexual (women: 43.6%; men: 24.9%) individuals compared with heterosexuals (women: 19.4%; men: 15.2%)[18]. Unfortunately, however, we were unable to include data about gender non-conformity in the present analyses, because questions concerning ACEs and childhood gender non-conformity were posed to non-overlapping segments of study participants.

A markedly higher prevalence of mental health problems among non-heterosexual than heterosexual individuals has also been previously reported in other datasets[12-14,25,26]. This increased mental morbidity may be interpreted within the frame of "minority stress", where adverse phenomena such as stigma, prejudice, discrimination and exclusion produce a hostile and distressing social environment for non-heterosexuals, leading to higher rates of mental health problems[13,26]. In a Danish context, we observed that stigma-related experiences are remarkably common in non-heterosexual persons. Among participants in the Project SEXUS cohort, sexual orientation-associated bullying or harassment was reported by as many as 51% of homosexuals and 13% of bisexuals. Additionally, experiences of sexual orientation-associated physical violence were reported by 18% of homosexuals and 5% of bisexuals[18]. A history of multiple ACEs has been reported to strongly increase vulnerability to interpersonal violence later in life[6].

Our study revealed that combinations of ACEs with a non-heterosexual identity were associated with markedly elevated odds of mental health problems. Only few prior studies have investigated such links between ACEs and mental health problems across different sexual identities. In a US study, researchers reported that the probability of substance use in combination with mental health disorders increased with higher numbers of ACEs, and that non-heterosexuals were at consistently higher risk of comorbid substance use and mental health problems than heterosexuals, irrespective of the number of ACEs[27]. In another US investigation carried out in high-school students, heterosexuals and non-heterosexuals with an ACE score of 2 or more had 4-fold and 13-fold greater odds, respectively, of suicidal ideation compared to heterosexuals reporting no ACEs[28].

In our study, bisexuals reported more ACEs than heterosexual and homosexual individuals, and they were at particularly elevated risk of mental health problems. The former finding is consistent with a US study reporting a higher prevalence of ACEs and a higher mean ACE score among bisexuals compared to both heterosexuals and homosexuals[11]. The observed greater burden of mental health problems in Danish bisexuals also accords well with other findings from the US, Australia and a recent meta-analysis, where bisexuality was more strongly associated with a range of mental health problems than heterosexual and homosexual orientations[13,15,26].

Reasons for the excess risk of both ACEs and mental health problems among bisexual persons are not well-established. However, having neither a heterosexual nor a homosexual identity has been suggested to somehow constitute an additional stressor on top of belonging to a sexual minority[15]. Bisexual individuals may also be more likely than homosexuals to lack social support[15,29] and to experience stress due to small or non-existent peer communities for bisexual people[13].

Associations between childhood circumstances and mental health among heterosexuals with or without same-sex sexual experience have received limited scientific attention. US researchers explored whether maltreatment in childhood increased the likelihood of same-sex sexual identity, behaviour and attraction in a nationally representative sample of more than 34,000 individuals, concluding that childhood sexual abuse and non-sexual maltreatment were positively associated with all three examined measures of non-heterosexual orientation[19]. Another large US study on the relationship between ACEs and substance use in combination with mental health disorders included five different sexual orientation subgroups: homosexual, bisexual, unsure, discordant heterosexual (with same-sex sexual attraction or behaviour) and concordant heterosexual (with no same-sex sexual attraction or behaviour). Higher prevalences of most ACEs and mental health disorders were observed among the discordant heterosexuals than among the concordant heterosexuals[27].

Additionally, in a prospective cohort of 946 New Zealanders, both women and men who reported even minor same-sex sexual attraction were at greater risk of self-harm than peers who were exclusively attracted to members of the other sex[30]. In combination with our findings, it appears that same-sex sexual behaviour and attraction exhibit rather similar associations as non-heterosexual sexual identity with indicators of poor mental health, implying that sexual non-conformity, i.e., any departure from strict

and exclusive heterosexuality, is somehow linked with a greater risk of mental health problems.

Our study has several strengths. Firstly, it is based on a large and detailed dataset comprising nationally representative baseline data in Project SEXUS, one of the world's largest cohort studies on sexual health[16,18]. Due to the large size of our dataset, we were able to investigate associations between ACEs and mental health problems across sexual identity categories for both women and men. Unlike several prior studies[8,24,28], we analyzed homosexual and bisexual respondents separately rather than pooling all non-heterosexuals in one group. Additionally, like only few other studies[19,27,30], we explored associations of ACEs with mental health problems not only across sexual identity categories, but also according to same-sex sexual experience among self-identified heterosexuals.

Our study also has some limitations. Due to the cross-sectional nature of our questionnaire data, we cannot make any firm causal inferences from the observed associations between ACEs and mental health problems among heterosexual, homosexual and bisexual participants or among self-identified heterosexuals with or without same-sex sexual experience. Additionally, potential bias resulting from different reporting probabilities for childhood adversities and mental health problems in the compared groups needs consideration. For instance, if non-heterosexuals are more likely than heterosexuals to recall ACEs or to report experienced childhood events as ACEs[10,19], information bias cannot be ruled out. Overall, however, we consider it unlikely that differential reporting, if present, would explain more than a small part of the observed marked excess of ACEs and mental health problems in non-heterosexuals and self-identified heterosexuals with same-sex sexual experience.

CONCLUSIONS

In this large, nationally representative study covering the age span 18-89 years, we document more ACEs and more mental health problems among non-heterosexuals than heterosexuals, and especially so among bisexuals. We also document a greater burden of mental health problems among self-identified heterosexuals with any same-sex sexual experience, and we show that combinations of ACEs with either a non-heterosexual identity or any same-sex sexual experience are associated with a markedly elevated burden of mental health problems.

Our findings, together with those of prior studies, indicate that ACEs may be partly responsible for the observed marked excess of mental health problems among homosexuals, bisexuals and self-identified heterosexuals with same-sex sexual experience, and they emphasize the public health importance of preventive measures to minimize the burden of ACEs and to avert their harmful long-term effects. Further, our study highlights the need to safeguard the integrity and welfare of children and adolescents with non-conforming expressions of sexuality. Finally, health care providers should keep in mind that there may well be clinically relevant links between patients' sex lives and their mental well-being.

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DOI:10.1002/wps.21008